Spectracom Corp.
101 Despatch Drive
East Rochester, NY 14445
(716) 381-4827

PRELIMINARY OPERATING MANUAL

MODEL 8150

PRECISION PHASE COMPARATOR

Because the final instruction manual for the Model 8150 is not yet available, this preliminary information is being furnished with each unit. The final instruction manual containing complete maintenance information will be sent to you when it is published. Please fill out the enclosed form and return it to SPECTRACOM so that the manual will be sent to the person responsible for the instrument's maintenance.

SPECTRACOM CORPORATION
101 Despatch Drive
East Rochester, New York 14445
(716) 381-4827

WARRANTY REGISTRATION

Dear Customer,

Spectracom occasionally contacts customers regarding our products. We must know to whom we should send manual updates, change notices, and new product information. Because people sometimes change job assignments, we request department, mail station, and title information to ensure that correspondence in future years will reach either the user of our products or his/her supervisor. In filling out the registration, please use the title/mail station/department of the supervisor most interested in keeping the equipment and its documentation up-to-date. Thank you.

- -

Name_____ Title_____

Department_____ Mail Stop_____

Company_____ Model Number_____

Address_____ Serial No._____

City_____ Date Installed_____

State_____ Zip_____

Phone_____ Ext._____

Remarks: (Problems, Suggestions, etc.)_____

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WARRANTY

Spectracom Corporation warrants to the original purchaser each new instrument to be free from defects in material and workmanship for a period of one year after shipment. Repair or replacement, at our option, will be made when our examination indicates that defects are due to workmanship or materials. Electron tubes, batteries, fuses, and lamps that have given normal service are excluded from warranty coverage. All warranty returns must first be authorized in wirting by the factory.

This warranty does not apply to any of our products which have been repaired or altered by persons not authorized by Spectracom Corp. or not in accordance with instructions furnished by us. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, or if any serial number or seal has been removed or altered, the warranty is void and repairs will be billed at cost.

This warranty is in lieu of all other obligations or liabilities expressed or implied and Spectracom Corp. neither assumes nor authorizes any person to assume for them, any other liability in connection with sales of its products.

REPAIR AND MAINTENANCE

Instruments should be returned only upon prior written authorization from Spectracom Corp. or its authorized sales and service representative. Warranty repair will be made upon written request. Please provide the following information in order to enable us to serve you efficiently:

1. Model Number and type
2. Serial Number
3. Description of trouble
4. Conditions and hours of use

Upon receipt of this information our service department will send you service data or shipping instructions. Transportation to the factory is to be prepaid by purchaser.

For assistance contact your nearest Spectracom sales representative.

INSTALLATION

UNPACKING

If the shipping carton is damaged when the unit is received, be sure to contact the carrier immediately so his representative can witness any equipment damage that may exist inside the carton. If there is hidden damage to the equipment, but the carton is not damaged, be sure to report this to the carrier immediately also. If you fail to report shipping damage to the carrier immediately, you may forfeit any claim you may have against the carrier. You should also notify SPECTRACOM CORPORATION of shipping damage so that we can help you get a replacement or repair the equipment.

Be sure to remove all items of equipment and accessories from the shipping carton before discarding it. Along with the basic equipment, you should find an ancillary kit and instruction manual.

RESHIPMENT

If it is necessary to return the unit to the factory for any reason, be sure to use the original shipping carton. If none is available, you may obtain another from the factory, or you may repack the unit in another carton of at least 250# test corrugated paper with at least two inches of polyethylene foam surrounding the unit. Seal the unit in a plastic bag for moisture protection, and include a note stating the reason for return.

OBTAIN PRIOR FACTORY AUTHORIZATION FOR ALL RETURNS

INPUT POWER

The equipment receives its necessary input power from the TM-500 Mainframe in which it is mounted. This mainframe may be operated from standard

115/230 VAC ± 10%, 60 Hz line power. See the operating manual for the TM-500 Mainframe that you are using for details.

OPERATING ENVIRONMENT

The instrument is intended for operation at room temperature laboratory environments between 0 and 50°C. Operation in temperature extremesoutside of this range may cause malfunction or damage to the instrument.

BENCH OPERATION

The TM-500 Mainframe has four feet for use upon a bench top surface, and a tilt stand which may be used for convenient viewing of the front panel.

OPERATING INSTRUCTIONS

8150 FRONT PANEL FUNCTIONS

Panel Meter: The front panel meter scale reads in microseconds of relative time between the phase of two input signals of almost equal frequency. Meter needle movement represents phase drift between the two signals. The rate of change of phase between the two signals yields frequency difference, or error. If the panel meter is made to stay perfectly still, there is no frequency error between the Reference Input and the Local Input. If the meter drifts downscale to the left, the local input frequency is low compared to the reference, and upscale drift indicates a positive frequency error. The meter scale factor depends on two things: The frequency of the input signals, and the push button switch that is activated just beneath the meter.

Push Button Selector Switch: These four buttons choose the frequency range of operation for the instrument and set the scale factor for the meter. The input frequencies must lie within the frequency range that is printed just below the button. The factor "N" printed just above the button establishes the factor by which the input frequencies are divided before going into the phase detector whose readout is shown on the panel meter. Full scale meter reading is determined by dividing N/F where N is the factor printed above the chosen push button, and F is the frequency in MHz of the input signals. For example, if the input signals are at 1.0 MHz, and the N = 1 push button is activated, the meter reads 1.0 microsecond full scale. If the N = 10 push button is chosen, full scale is 10 microseconds. Later paragraphs describe in more detail the calculation of frequency error based on this information.

Reference Input: This jack accepts any input signal level between 0.1 and 10 volts rms, at frequencies between 10 KHz and 32 MHz. The signal fed into this jack becomes the reference standard against which the local input is phase compared.

Local Input: This jack takes the Local Input signal (between 0.1 and 10 volts rms, into 1000 ohm input Z) which is to be compared against the reference input.

Auxillary Output: On standard units this jack provides an output for driving a remote strip chart recorder or meter which reads the same as the front panel meter. This jack will drive any 0-1 ma meter movement or strip chart recorder.

Divider Output: This jack provides an output signal derived from the Local Input frequency divided by N as chosen with the push button selector switch.

INITIAL TURN-ON

Plug the Tektronix TM-500 Mainframe into the power line and, with the power switch in the OFF position, insert the Model 8150 plug-in into the Mainframe, making sure that it is well seated. Turn on the Mainframe power switch. If an input signal is fed to the Reference Input only, the panel meter should read at zero scale. Feeding both a Reference Input signal and a Local Input signal into their appropriate panel jacks will result in needle movement across the scale, with the rate of movement proportional to frequency error.

USING THE PHASE COMPARATOR

An initial illustration of the simplicity of operation of this instrument may be provided by feeding two nearly equal 1 MHz signals into the input jacks. If the signals are within, say, a few parts in 10^8 of each other, the meter will move to the right if the local input is higher in frequency compared to the reference, and will move to the left if the local input is low in frequency. The rate at which the meter moves is proportional to the rate of change of phase between the two signals, and is also proportional to frequency error.

When the meter reaches one end of the scale it will suddenly return to the opposite end of the scale and begin its slow travel in the same direction again. If the frequency error between the two signals decreases, the rate of needle movement will also decrease and vice-versa. If the meter reading is perfectly constant, there is zero drift in the phase relationship, and the local signal is exactly at the same frequency as the reference input. If the meter moves slowly it is recording phase drift or slight frequency error.

With the push button set at N = 1, the input signals are not divided to a lower frequency for the phase comparison (they are divided by 1), and for a 1 MHz input signal, a complete deflection of the meter from end to end represents 1 microsecond (360° at 1 MHz). This is the most sensitive setting of the instrument, as other choices of higher values of N will yield larger full scale readings. For instance, if the input signals are at 1 MHz and N = 100, complete deflection of the meter from end to end now represents 100 microseconds, and for a given frequency error the meter needle will travel more slowly than for lower values of N. When N = 100 the input frequencies are divided by 100 for the phase comparison, and thus a 1 MHz input signal is divided to 10 KHz for the phase comparison, causing the scale to represent 100 microseconds from end to end (360° at 10 KHz).

If you are adjusting your local frequency, set it so that the meter is not moving. It is generally advisable to make the initial setting of your local frequency with N = 100, or the least sensitive setting of the instrument. As you adjust your local frequency to cause the phase drift to be slower and slower, you may choose more and more sensitive settings, or lower values of N, as you get closer in frequency to the reference. The longer you monitor the phase drift, the greater the potential precision of your calibration. For very long observations over periods of hours or days, you will want to use the chart recorder trace, rather than visual observations of the meter.

When the local frequency is in error by a large amount, the phase reading may be changing too rapidly for the meter to follow. In this case the auxillary output of the phase comparator may be viewed with an oscilloscope. Adjust your local oscillator so that the frequency of this sawtooth signal is as low as possible, then use the panel meter when it is moving more slowly.

FREQUENCY ERROR CALCULATION

Frequency error is measured by noting the speed with which the meter deflects in its slow travel across the scale, or in other words, by noting the slope of the recorder trace on the paper. Here is an example:

Suppose that in a three hour period, the recorder trace moved from left to right a total distance of 160 microseconds. If the scale setting was 0-50 microseconds, this would amount to the trace moving completely across the paper from left to right slightly more than three times. Hours are marked along the length of the chart paper. The calculation is made by dividing the phase movement expressed in seconds by the time during which the movement occurred, also expressed in seconds:

$$\frac{\text{Phase Movement (seconds)}}{\text{Time for Movement to Occur (seconds)}} = \frac{160 \times 10^{-6}}{3 \times 3600} = 1.48 \times 10^{-8}$$

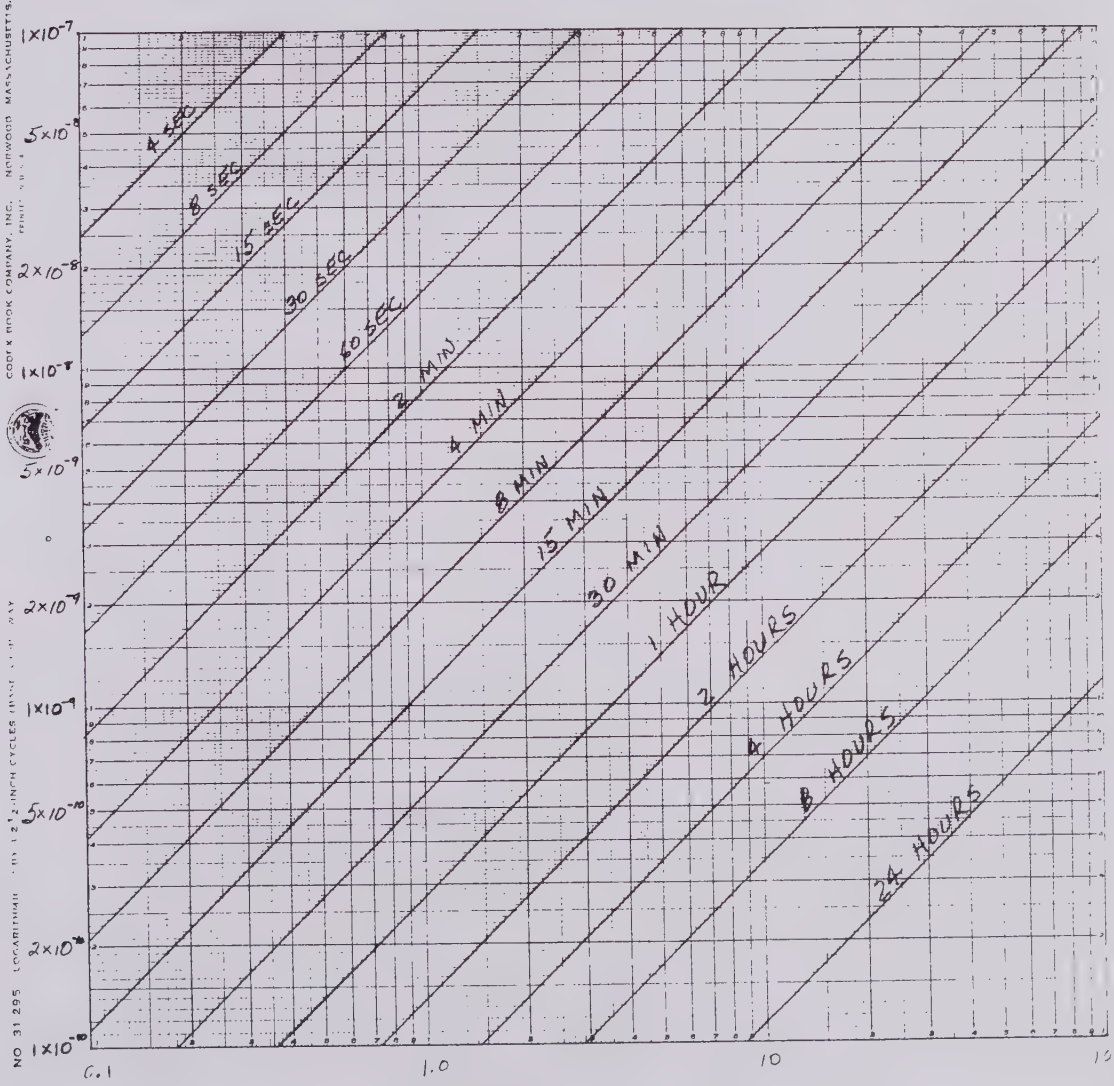
Thus, in this example, our local frequency is high by about 1.5 parts in 10^8, or .015 parts per million.

INPUT SIGNALS

Input signals may be anywhere between 0.1 to 10 volts rms. Input impedance for both input jacks is approximately 1000 ohms. Thus, if you are feeding signals into the comparator from a long distance away through a coax cable, mismatches may occur on the line and signal levels may not be sufficient. This is usually more of a problem at the higher frequencies, say at 10 MHz and above. If a line mismatch problem occurs it can usually be avoided by using shorter lengths of coaxial cable.

FREQUENCY STABILITY

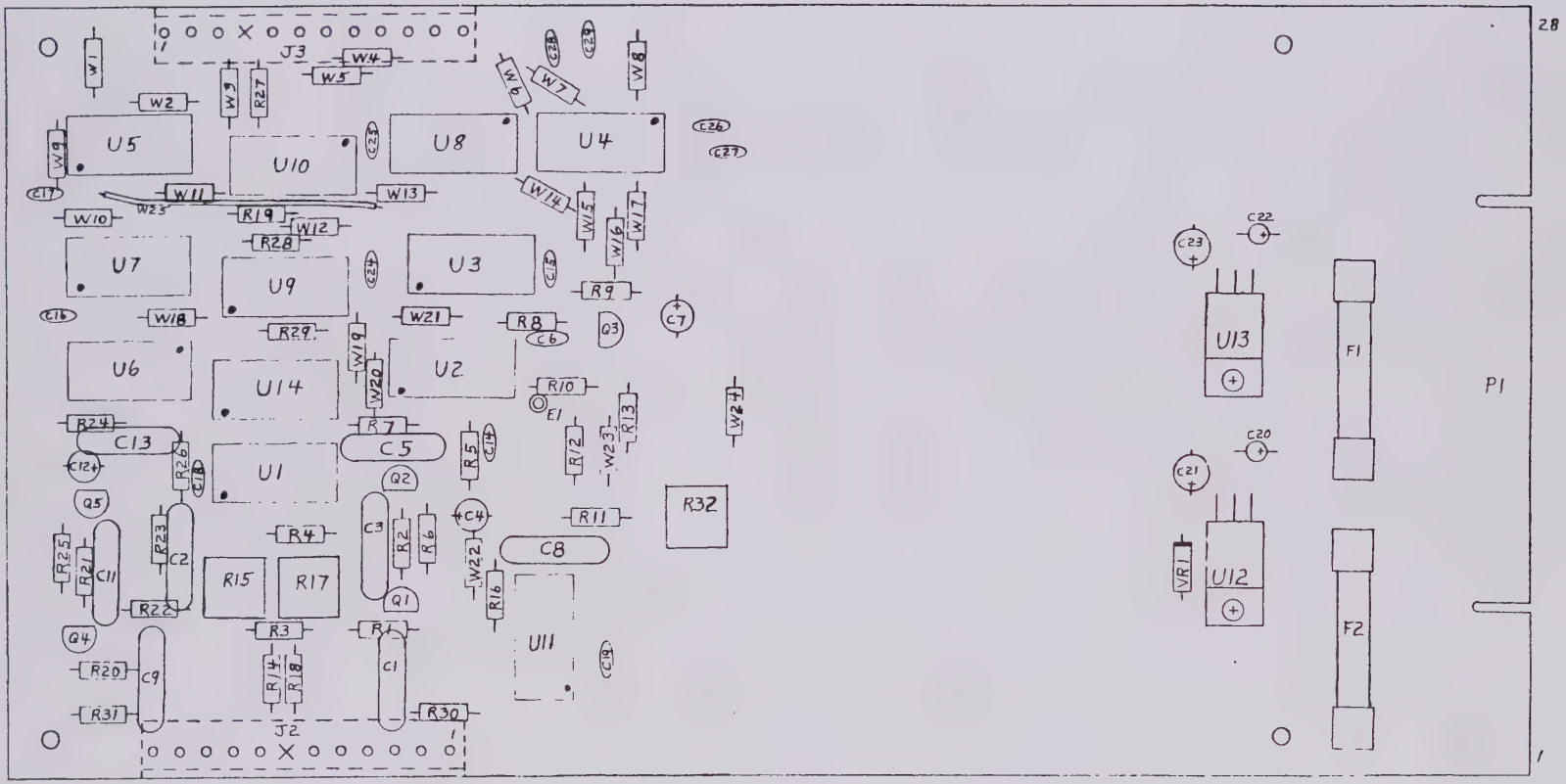
SPECTRACOM CORPORATION



COOK BOOK COMPANY, INC. NORWOOD MASSACHUSETTS

NO 31 295 LOGARITHMIC 1 IN 12½ INCH CYCLES

R.J.T. 11/14/78



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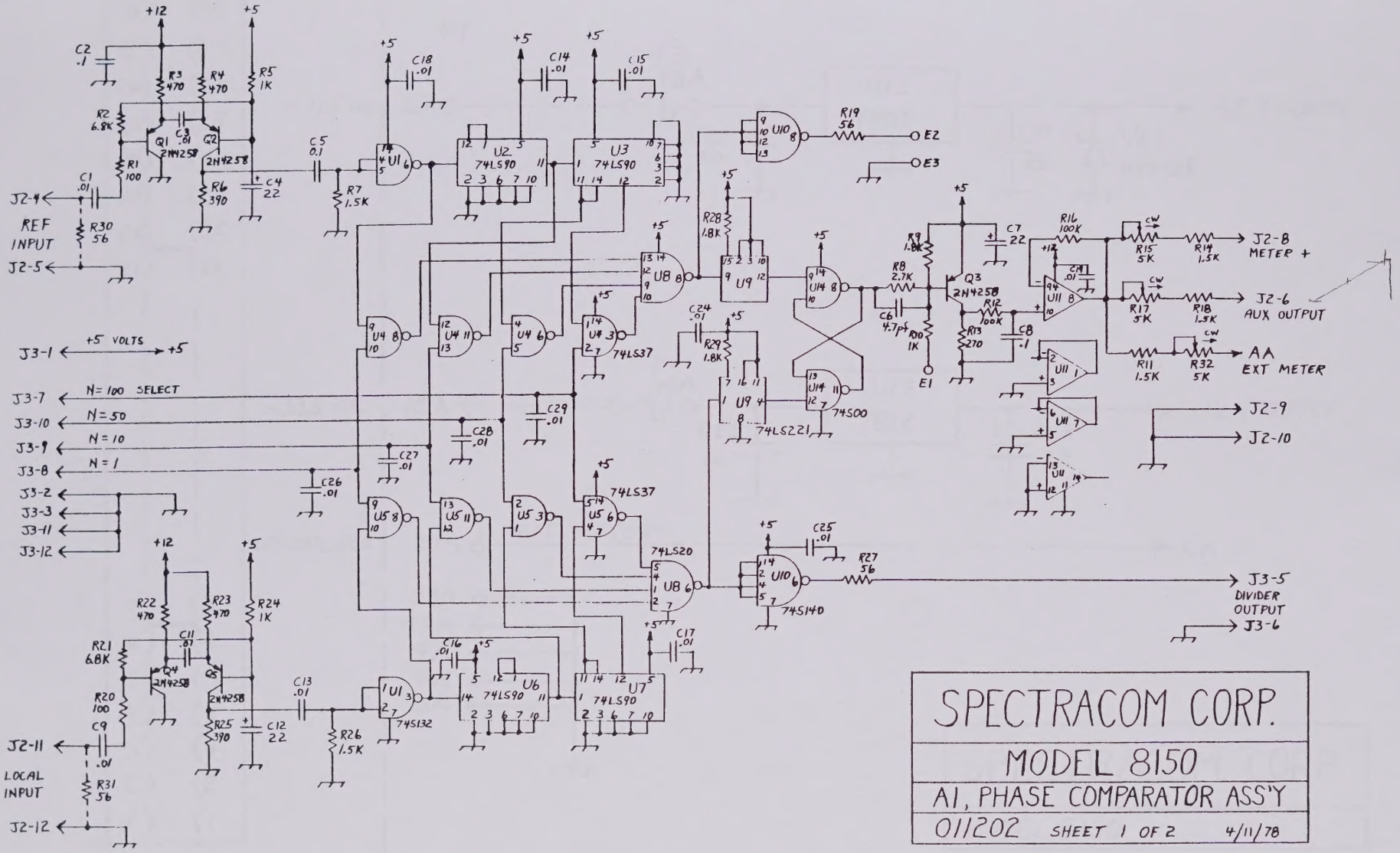
A1, PHASE COMPARATOR		
8150		DRAWING NUMBER 011200



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MODEL 8150

A1, PHASE COMPARATOR ASS'Y

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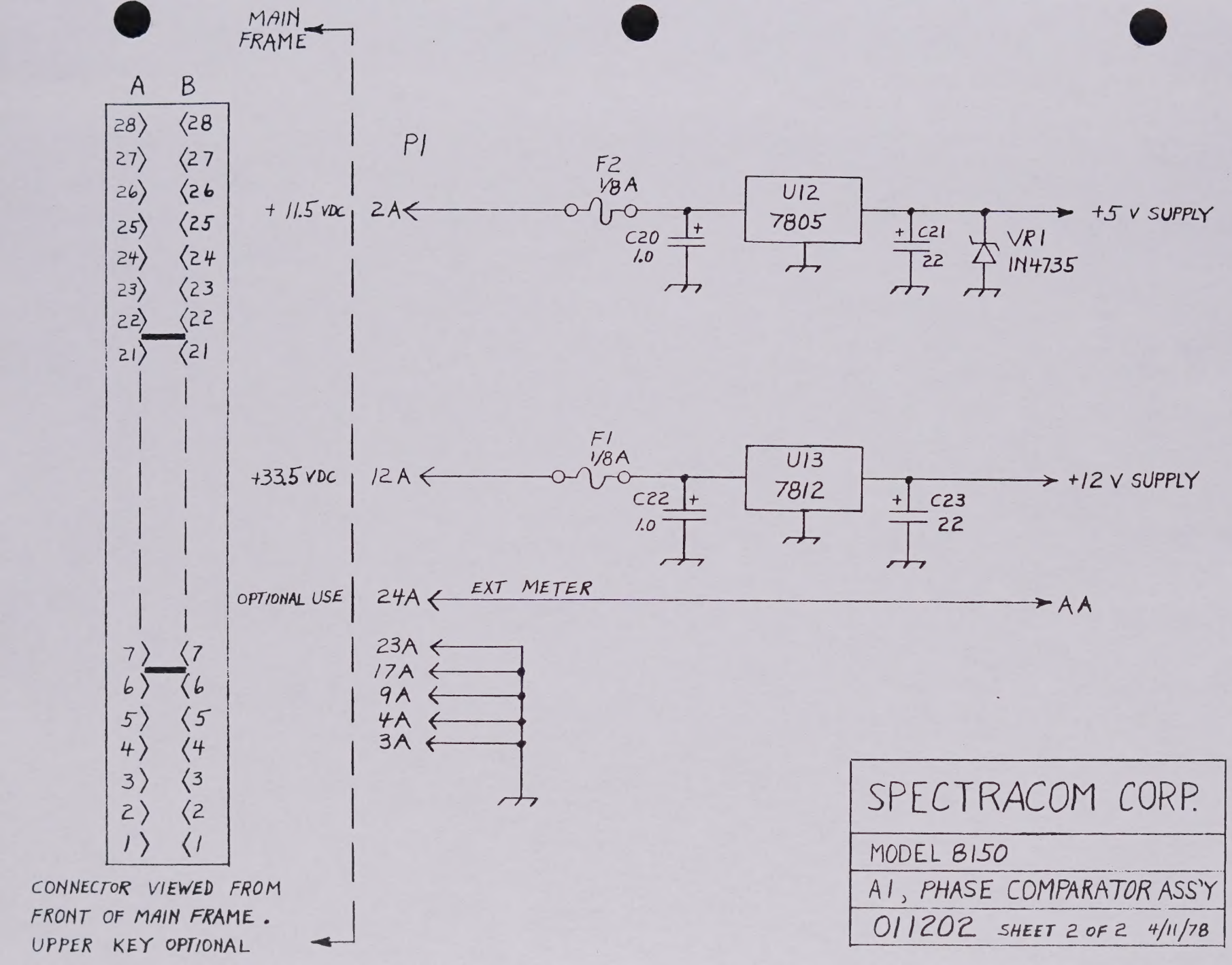

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